JOINT MANAGEMENT PLAN REVIEW
DRAFT ACTION PLAN:
Coastal Development: Desalination

REVISED: March 17, 2003

***Please Note**: The MBNMS and the Sanctuary Advisory Council have tasked the management plan working groups with development of draft action plans that characterize the issue or problem and identify strategies and activities that address the issue. The working groups will develop these strategies and activities as they meet over the next several months. With this goal in mind, the progress of the group, the decisions, areas of agreement will be outlined in a progressively developed action plan identifying draft goals, issue characterizations, and strategies and activities. Members of the group as well as other interested parties should look to this draft action plan as it develops as a way of tracking the group's progress and decisions.*

Introduction

Desalination is the process by which salts and other chemicals are removed from salt or brackish water and other impaired water resources. It is also known as Desalinization or Desalting or commonly referred to as "desal". As traditional sources of fresh water continue to be depleted and degraded, society is increasingly looking toward desalination as an option for obtaining water for both private, and municipal freshwater supply. In the past it has not been used extensively in this country, primarily because the cost of the product water has been so much higher than that from conventional sources. With more efficient desalting technologies being able to produce the water cheaper, in conjunction with escalating costs of obtaining fresh water from conventional sources, desalination is likely to look more and more attractive as an option to many proponents.

While desalination refers to any technology that removes salt from water, it includes a wide range of technologies that fall into two main categories, with many variations on each. Distillation processes involve heating the intake water to produce steam, which is then condensed to produce water with a very low salt concentration. Reverse Osmosis (RO) refers to the processes in which intake water is pressurized and forced through a semi-permeable membrane. The water passes through the membrane, but the salt molecules do not. With either technology, after the desalting process both fresh water and concentrated saline brine are produced. RO is the predominant technology being used and proposed in the Sanctuary region.

Three desalination facilities currently operate within the boundaries of the Sanctuary; however there has recently been an increase in interest for both private and public desalination plants. Approximately ten facilities have recently been proposed. Rather than

utilizing a coordinated regional planning approach, each plant has been conceived and designed as a separate project. Due to population growth in the area, continuing shortages and degradation of conventional water supplies, and advances in desalination technology, the trend will likely continue. Desalination plants have the potential to negatively impact the marine environment through the introduction of brine waste effluent and other substances to Sanctuary waters. Additionally, the construction of desalination facilities and associated pipelines often causes alteration of the seabed.

This action plan lays out a framework for a regional approach to address desalination, aimed at reducing impacts to marine resources in the Sanctuary through consideration of regional planning, facility siting issues, on-site mitigation measures, modeling and monitoring, and outreach and information exchange. While the Sanctuary is concerned with potential growth inducing impacts associated with increased supplies of water from desalination facilities, decisions regarding water supply and use will ultimately fall to local governments (cities and counties), the California Coastal Commission, and water agencies, to address and resolve. It is also the responsibility of these agencies to ensure that all alternatives have been analyzed, and that desalination is a necessary option.

Potential Impacts of Desalination:
Desalination impacts vary widely and typically vary based on the specifics of each site. The degree of the impacts in large part depends on overall plant design and operation, methods used for effluent disposal and specific physical and biological conditions in the vicinity of the plant. While desalination can cause adverse environmental effects, there are often effective mitigation measures that can be taken to reduce impacts. Furthermore, it is important to consider that all other methods of obtaining municipal fresh water also involve major environmental impacts. This is especially the case when salt-water intrusion, or damage to anadromous or endangered species habitat caused by over-drafting of water from aquifers, rivers, and streams, are an issue.

Construction of a desalination facility, especially if new offshore pipeline construction is involved, can have significant environmental impacts, including disturbances to seafloor, surf zone, and dune ecology. By using existing pipeline structures or alternative technologies such as injection wells or percolation galleries, benthic impacts can be minimized or eliminated altogether.

The Sanctuary is also concerned with the discharge of the hyper-saline water that remains as a byproduct from the desalination process. This brine effluent is generally about twice as salty as the ambient seawater, however this varies depending upon the specific technology being used, and can range anywhere between 46 and 80 parts per thousand (ppt) (typical salinity in the region of the MBNMS is around 33ppt). This effluent is denser than seawater and tends to sink to bottom where it becomes concentrated. Both high levels of concentration, and fluctuations in salinity levels may kill sensitive organisms near the outfall. While tolerances vary among organisms, more research is

needed to determine the extent of impacts for various species found in the MBNMS. The impacts of the brine effluent vary widely as a function of the location of the outfall. Impacts are generally more severe in rocky substrate than sandy seafloor habitats. Other issues associated with the discharge are: increased turbidity; and concentration of organic substances and metals that are contained in the feed waters. Additional impacts specific to distillation facilities include concentration of metals picked up through contact with the plant components, thermal pollution and decreased oxygen levels.

While if unmitigated, the impacts caused by brine effluent can be severe, there are many existing measures that can be taken to minimize these impacts. Certain technologies such as injection wells or percolation galleries minimize the impact from the saline brine discharge due to adequate mixing of brine and ambient seawater. Diffusers of appropriate design and number, used with open ocean disposal structures also can facilitate mixing of desalination discharge with ambient seawater in a limited mixing zone. Certain plants, such as the one located in the City of Marina, and the proposed Sand City facility utilize brackish groundwater as a feed water source; this results in a brine reject that is lower in salinity than typical brine effluent from similar facilities that desalt seawater.

Intake of water directly from the ocean usually results in loss of marine species as a result of impingement and entrainment. Impingement is when organisms collide with screens at the intake, and entrainment is when species are taken into the plant with the feed water and are killed during plant processes. Impingement and entrainment impacts can be mitigated by the use of certain designs and technologies. Properly engineered intake structures can reduce the potential for entrainment and impingement, and in certain cases the need for chemicals. Structures such as onshore intake wells or infiltration galleries have been proven highly effective. Appropriately sized screens at the intake, as well as low velocity water flow are potential mitigation measures for open water intake structures.

Clearly the most contentious and controversial issue surrounding desalination is its potential to induce community growth. Along most of the California coast, fresh water supply is the limiting factor for community growth. With the addition of an unlimited source of freshwater, growth can be allowed to occur. While this issue is not addressed directly by Sanctuary regulations, it is of major concern. Increased development of the coastline adjacent to the MBNMS could lead to degradation of water quality and many other challenges to the protection of Sanctuary resources. It is up to local jurisdictions to ensure that a proliferation of desalination facilities does not lead to unsustainable community growth, through responsible planning, and limitations in plant capacities. This issue is addressed by many other agencies including the California Coastal Commission, and local jurisdictions.

Desalination in the Sanctuary:

Sanctuary management is concerned with desalination, because it has the potential to negatively impact the marine environment through the introduction of brine waste effluent and other substances to Sanctuary waters. Additionally, the construction of desalination facilities and associated pipelines often causes alteration of the seabed. Three of the Sanctuary's regulations relate directly to desalination. The first involves a prohibition on discharging or depositing any material from within Sanctuary boundaries. Since the brine effluent, and in some cases other materials, are usually disposed of in ocean waters, this activity requires Sanctuary authorization of Regional Water Quality Control Board (RWQCB) permits. The second Sanctuary regulation pertains to discharging materials outside of the boundaries, which subsequently enter Sanctuary waters and negatively impact MBNMS resources. As with the previous regulation, Sanctuary approval via authorization of the RWQCB permit is required. The third relevant regulation involves a prohibition on activities that cause alteration of the seabed. Thus installation of certain desalination facility structures such as an intake/outfall pipeline on or beneath the ocean floor will also require Sanctuary authorization.

Three small desalination plants currently operate in the Sanctuary:

Duke power plant, in Moss Landing contains a seawater distillation plant that produces a little less than 0.5 million gallons per day (MGD) for use in its boiler tubes for the power production process. This facility uses power plant cooling water as the source for the desalination feed water and brine effluent discharge. Due to the large volume of cooling water being discharged by the plant, the brine effluent is diluted and impacts from the salinity are eliminated.

A small plant, operated by the *Marina Coast Water District* in the City of Marina with the capacity of 0.45 MGD, currently supplies about 13% of the city's annual municipal water consumption. This plant uses a beach well for intake water, and an injection well for discharging brine effluent. This facility was originally built in 1996, and will be renovated in the near future, with new technologies that will greatly increase its efficiency.

The *Monterey Bay Aquarium* operates a very small facility that provides about 0.040 MGD for maintenance purposes such as flushing the toilets. The saline brine discharge is blended with, and effectively diluted by the exhibit water outfall.

Although there are currently only three facilities in operation, there has recently been an increase in proposals for both private and public desalination plants. There are approximately ten additional facilities in the Sanctuary region that are in some stage of initial consideration or planning. These range from small, less than 50,000 GPD private facilities such as the proposed RO plant for the Ocean View Plaza to be built on Cannery Row in Monterey, to larger multi-city regional projects like the ones the City of Santa Cruz and Monterey Peninsula Water Management District are currently investigating.

There are also several proposals for small to medium size projects to serve a single city, such as the proposed plants in Cambria, or Sand City. Due to population growth in the area, continuing shortages and degradation of conventional water supplies, and advances in desalination technology, the trend will likely continue.

COMPONENTS OF THE DESALINATION ACTION PLAN

STRATEGY MB- DESAL 1 DEVELOP A REGIONAL PLANNING PROGRAM TO ADDRESS DESALINATION IN THE MBNMS

There is a need for a comprehensive regional approach to address the issue of desalination, to minimize the impacts to resources. This will provide increased coordination and planning among desalination proponents and relevant agencies who are now dealing with an array of independent desalination proposals

Activity A: Develop a regional planning approach to desalination

Planning program will take into consideration siting, volume of water requested, service areas, and potential collaborations.

1. Investigate potential for use of full capacity of existing desalination facilities before approval of construction of new plants

2. Develop system to improve tracking of new desalination proposals in order for the Sanctuary and other agencies to enter into discussion with desalination plant proponents and interested parties early on in the process

3. Develop system for improved coordination among agencies involved in permitting desalination, and among interested parties. Consider establishment of a Joint Review Panel to coordinate environmental review and decision making on larger projects, which require Federal, state, and local approvals as well as CEQA and NEPA review

4. Evaluate regional opportunities for joint facilities serving multiple jurisdictions, collocation of facilities at existing discharge sites, etc.

Activity B: Encourage development of a regional plan to address and mitigate the potential for growth-inducing impacts

1. This should be developed by the California Coastal Commission and local jurisdictions

2. MBNMS will participate by sharing information and concerns on potential impacts of growth to Sanctuary resources

STRATEGY MB- DESAL 2*:* DEVELOP DESALINATION FACILITY SITING GUIDELINES AND RECOMMENDATIONS TO MINIMIZE IMPACTS TO MBNMS RESOURCES

Environmental impacts in large part depend on specific physical and biological conditions in the vicinity of the facility, including the intake and outfall. Through proper siting of facilities and intake/outfall structures, impacts can be minimized.

Activity A: Identification of preferred conditions and habitats types that are the most resilient to the impacts of brine effluent, as well as sensitive species and habitats where brine effluent disposal should be avoided

Activity B: Develop recommendations and guidelines for siting of intake and outfall structures:

1. Require appropriate outfall siting and design to ensure adequate mixing and dilution of brine effluent, to avoid areas with limited water circulation, and to an appropriate depth and distance offshore

2. Encourage use of appropriately sited existing pipelines of acceptable structural integrity rather than construction of new ones, which may cause seabed alteration. Considerations include:

    - Mixing of brine effluent with power plant cooling water or sewage treatment plant discharges where appropriate. When co-location is an option, ensure that temporal variations in operation, and maintenance of facilities are addressed to ensure sufficient dilution of brine effluent.

    - If necessary, investigate the potential for upgrading existing pipelines if potential exists for use as desalination intake/outfall structure

3. In cases where new pipeline construction is required, ensure proper routing and construction techniques to minimize environmental and recreational impacts

4. Intake siting and design to minimize impingement and entrainment impacts

5. Consideration of the potential for the effluent to be entrained in the intake

6. Consideration of the quality of the water in the vicinity of the intake, to avoid the potential for concentration of contaminants in the feed water

Activity C: Develop recommendations and guidelines to ensure that planned facilities consider:

1. Aesthetic, recreational, public access, and safety aspects:

2. The effects of surface waves, circulation, density, mixing, and turbidity on the dispersal of brine effluent

3. Surface wave and sea level effects and geological considerations including earthquake hazards, liquefaction, sand transport patterns, and beach erosion rates for proposed structures to be located on or near beach

4. Review of alternatives analysis for water supply needs and supply options under CEQA

5. Emergency contingencies and incorporation of system-wide fail safe technologies to address the potential for emergency scenarios (mechanical failures, terrorist attacks, etc.)

STRATEGY MB- DESAL 3: DEFINE ENVIRONMENTAL STANDARDS FOR DESALINATION FACILITIES OPERATING IN THE MBNMS

Specific engineering and design aspects of desalination plants are a major determinant of the severity of the impacts. There is an increasingly wide range of different technologies available, including many promising new advances in intake design, pretreatment, reverse osmosis, and brine disposal technology. This strategy recognizes the need to minimize the adverse impacts to marine resources, through proper design and operation considerations. The Sanctuary will define specific standards that proposed facilities will be required to meet through proper design and engineering. Compliance with standards will be measured using requirements included in Strategy MB-Desal 4: Modelling and Monitoring Requirements, of this document.

Activity A: Define limits for salinity levels, and other constituents of brine effluent in collaboration with other regulatory agencies. Standards will be met through:

1. Use of appropriate brine effluent disposal techniques to avoid or minimize impacts from elevated salinity

2. Mitigation of other potentially toxic, introduced and naturally occurring constituents of the brine prior to discharge including:

    - Use of pretreatment techniques that minimize or eliminate the need for potentially toxic chemicals

    - Use of materials that minimize the corrosion of hazardous substances

Activity B: Define an environmental standard for entrainment and impingement impacts to be met through:

1. Special intake design to reduce the potential for entrainment and impingement e.g. mesh screens and diversion screens, onshore intake wells or infiltration galleries.

2. For those intakes located in the water column, low flow velocities in the intake channels to minimize impingement of marine species.

STRATEGY MB- DESAL 4: DEVELOP MODELING AND MONITORING PROGRAM

There is a need for a comprehensive modeling and monitoring program, to determine predicted properties of brine plume, and measure short and long term, and cumulative impacts. The program will include information requirements for parties seeking permits, as well as a multi-tiered modeling and monitoring program. This multi-tiered approach includes identifying different levels of requirements based on characteristics of a proposed facility such as its location, the biological sensitivity of the habitat near its intake and outfall, specific properties of the brine discharge plume, and other characteristics.

Activity A: Establish regional guidelines for modeling of expected brine effluent plumes:

1. Evaluate accuracy of existing plume and circulation models applied to desalination, including field testing if necessary

2. Acceptance of credible models that will be a standard for the Sanctuary.

3. Establish a standard for defining zone of initial dilution

Activity B: Develop standard information requirements that would apply to all proposed facilities seeking permits to include:

1. Initial evaluation of recreational, public use, and commercial impacts in vicinity of desalination facility

2. Initial monitoring to determine currents, tides, water depth and similar parameters of receiving waters

3. Pre-construction biological analysis with consideration of seasonal variability, of marine organisms in the affected area and control site to include indices, species richness, and abundance, along with evaluation of entrainment and impingement impacts.

4. Pre-construction estimation of expected brine composition, volumes, and dilution rates of the brine in the zone of initial dilution

5. Plan for toxicity testing of the whole effluent as an ongoing monitoring requirement

6. Studies to determine properties of combined discharges (cooling water or sewage), and their effects and toxicity on local species

7. Post-operational monitoring of salinity in zone of initial dilution and control site, as indicator for plume spreading and dispersal, to be compared with expected results from plume and circulation modeling. If not in compliance the identify and implement corrective actions

8. End of pipe monitoring to verify results from expected brine composition and dilution

Activity C: Develop additional requirements for those proposed facilities that may affect sensitive habitats or may have increased or significant impacts on coastal resources:
Based upon sensitivity of habitat in vicinity of the discharge and size of zone of initial dilution, additional requirements may include:

1. Pre-construction monitoring of affected area as well as a control site, to include sampling of water column, and sediments

2. Post operational monitoring of affected area as well as a control site, to include sampling of water column and sediments, to be compared with pre-operational monitoring results

3. Post operational monitoring of oxygen levels, turbidity, heavy metals or other chemical concentrations, with regard to water quality standards

4. Post operational sampling of sediments for heavy metals to monitor possible accumulation. (Possible bio-monitoring to sample tissues for heavy metals)

5. Post-operational biological analysis of marine organisms in the affected area and control site including indices, species richness, and abundance, to be compared with the pre-operational results

6. Monitoring of long term impacts of discharge (e.g. potential changes in species composition etc.)

Activity D: Develop a regional monitoring program to determine cumulative impacts from multiple facilities, to include:

1. A method to assess the potential cumulative impacts of saline brine effluent, on Sanctuary biological resources

2. Modeling of entrainment and impingement for impacts of the total volume of intake water removed from multiple sources

STRATEGY MB- DESAL 5*: DEVELOP STRATEGIES FOR OUTREACH AND INFORMATION EXCHANGE*

The Sanctuary will conduct extensive outreach on the guidelines and recommendations developed by this working group.

Activity A: Develop strategies for education and outreach to agencies, desalination plant proponents, and other interested parties about the guidelines as well as relevant regulations

Activity B: Develop strategies for outreach and education to general public and agencies about desalination issues and potential impacts on Sanctuary resources

Activity C: Develop strategies to track desalination activities outside of the Sanctuary

Activity D: Develop a program for evaluation of new and emerging desalination technologies, and a system to incorporate these into existing and proposed plants

Activity E: Conduct outreach to agencies and local jurisdictions to share information and concerns on potential impacts of community growth on Sanctuary resources

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